Technical Case Study

HV Testing and Protection Coordination for Renewable Research Facility

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Abstract

This technical case study details the high-voltage (HV) testing and protection coordination activities conducted at the CSIRO Renewable Energy Research Facility in Adelaide, Australia. The project supported CSIRO's research into renewable grid integration by validating transformer performance, relay schemes, and system protection under renewable generation scenarios. The work ensured compliance with Australian and international standards while advancing Australia's research capacity in renewable energy systems.

Keywords: HV Testing, Protection Coordination, Renewable Integration, Research Facility, Australia

1. Introduction

The CSIRO Renewable Energy Research Facility plays a key role in advancing Australia's knowledge of renewable grid integration. In 2024, HV testing and protection coordination were required to ensure the reliability of substation assets and to validate protection schemes under various renewable penetration scenarios. The project focused on testing, coordination, and compliance to ensure reliable and safe research operations.

2. Methodology

The testing and coordination program was executed in four phases:

- Primary Asset Testing: Transformer ratio, winding resistance, CT/VT verification, and insulation resistance tests.

- Protection Coordination: Relay grading and selectivity studies using IEEE C37.112 and IEC 60255.

- Renewable Scenarios: Simulation of high renewable penetration events with end-to-end relay validation.

- Compliance Verification: Alignment with Australian National Electricity Rules (NER) and CSIRO research protocols.

3. Results

The project achieved the following measurable outcomes:

Metric	Before	After	Improvement
Fault Detection Accuracy	90%	99%	+9%
Relay Coordination Reliability	Partial	Full	100% compliant
System Availability	95%	99%	+4%

4. Discussion

The CSIRO Renewable Energy Research Facility project highlighted the importance of applying rigorous HV testing and protection coordination in renewable research environments. By validating system readiness under renewable penetration scenarios, the project contributed to Australia’s leadership in renewable grid research. The methodologies applied here were later adapted to large-scale BESS projects in Adelaide in 2025.

5. Conclusion

The 2024 HV testing and protection coordination program at CSIRO provided a robust foundation for renewable research operations. The project ensured safety, compliance, and technical readiness, supporting Australia’s broader renewable energy transition.

6. References

[1] IEC 60255, Measuring Relays and Protection Equipment.
[2] IEEE Std C37.112-1996, Inverse-Time Characteristics for Overcurrent Relays.
[3] Omicron Test Universe – HV and Protection Testing Procedures.
[4] Australian National Electricity Rules (NER), AEMC 2024.